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MONTHLY WEIGHT AND BALANCE REPORT (U)

FOR THE APOLLO SPACECRAFT

CONTRACT NAS 9-150

1 December 1962

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Prepared by

Weight Control Group

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INTRODUCTION

In this report the authorized weight column has been removed from the module status sheets. A revised format for the EOR and LOR mission summary is included indicating centers of gravity and inertias incorporating estimated values for the LEM. A more detailed breakdown is shown for the S/M propulsion system.

The major changes in the command module weight since the last report are in the structure, guidance and navigation, and electrical systems. The current basic structural weight is based on drawings which are about 82% calculated. The 40% calculated value shown on the status summary is lower because of the ablator weight which is assumed to be estimated. Potential weight reductions in structure are discussed in the potential weight changes but cannot be reflected in the current weight until they are accomplished by released drawing change.

The major changes in the service module weight since the last report are in the structure and electrical system. The current basic structural weight is based on a revised estimate of the structural design and of the insulation. The potential weight reduction reflected in the November report was accomplished and incorporated. In addition, the structural insulation weight was reduced about 200 pounds by utilizing a lower density material. The weight increase in the electrical system is due to incorporating increases in the P & W and Beech status reports.

The total spacecraft weight at injection increased by 70 lbs. and at S/M burnout 30 pounds. The current injected weight with the service module loaded with sufficient propellant to provide a 10 per cent ΔV margin is 84,465. This is based on LEM weight, including crew, of 25,000 lb.

APOLLO LOR MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT^2)*		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	9350	1042.6	1.2	8.2	3934	3989	3714
SERVICE MODULE - Less Propellant	10205	908.5	-0.4	-0.9	7509	12576	12413
TOTAL - Less Propellant	19555	972.6	0.4	3.5	11536	35602	35078
PROPELLANT	37190	905.8	5.6	-2.4	19300	20200	26100
TOTAL - With Propellant	56745	928.8	3.8	-0.4	31363	68253	73611
LAUNCH ESCAPE	6655	1295.2	0	0	228	8879	8879
LUNAR EXCURSION MODULE	24460	623.0	0	0	13616	12776	13247
ADAPTOR - LEM	3260	645.0	0	0	6463	4692	4692
TOTAL - SPACECRAFT LAUNCH	91120	863.3	2.4	-0.2	51381	753711	759605

NOTE: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

APOLLO EOR MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT^2)		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	9350	1042.6	1.2	8.2	3934	3989	3714
SERVICE MODULE - Less Propellant	10205	908.5	-0.4	-0.9	7509	12576	12413
TOTAL - Less Propellant	19555	972.6	0.4	3.5	11536	35602	35078
PROPELLANT	17875	900.2	27.0	-11.7	6100	7500	8200
TOTAL - With Propellant	37430	938.0	13.1	-3.8	19529	54138	55360
LAUNCH ESCAPE	6655	1295.2	0	0	228	8879	8879
ADAPTER - C-1	800	770.0	0	0	831	562	562
TOTAL - SPACECRAFT LAUNCH	44885	988.0	10.9	-3.2	20836	227707	229061

NOTE: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

COMMAND MODULE

WEIGHT AND CENTER OF GRAVITY SUMMARY

VEHICLE CONFIGURATION	LAUNCH ABORT CONDITION				ENTRY CONDITION (LUNAR MISSION)			
	WEIGHT	X	Y	Z	WEIGHT	X	Y	Z
Earth Launch	(9350)	1042.6	1.2	8.2	(9350)	1042.6	1.2	8.2
Add: Unexpended Waste & Water	-	-	-	-	112	-	-	-
Shift Crew to Entry Position	-	-	-	-				
Prior to Entry	-	-	-	-	(9462)	1042.5	0.7	9.9
Less: Propellant RCS	-	-	-	-	-210	1022.6	3.5	52.0
Ablation Material Burnoff	-	-	-	-	-314**	1019.7	0.0	11.2
Nose Cone & Discone Antenna	-287*	1100.8	0.0	0.0	-264	1099.2	0.0	0.0
Drogue Chute	-25	1090.0	11.0	-22.0	-25	1090.0	11.0	-22.0
Prior to Main Chute Deployment	(9038)	1040.6	1.2	8.5	(8649)	1041.9	0.6	9.2
Less: Main Parachutes (3)	-385	1092.0	0.0	8.6	-385	1092.0	0.0	8.6
Shift Crew to Land Landing Position								
Landing	(8653)	1038.3	1.3	8.6	(8264)	1039.6	0.7	8.1

*Represents nose cone with ablative material intact.
**Based on 21% ablation burnoff.

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SPACECRAFT

WEIGHT STATUS SUMMARY

ITEM	PREVIOUS STATUS 11-1-62	CHANGE TO CURRENT	CURRENT WEIGHT 12-1-62	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
COMMAND MODULE	8760	+590	9350	68	31	1
SERVICE MODULE	55765	-560	55205	14	86	
LES	6495	+160	6655	42	58	
ADAPTER	3260		3260	100		
TOTAL	74280	+190	74470	27	73	-

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COMMAND MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 11-1-62	CHANGE TO CURRENT	CURRENT WEIGHT 12-1-62	BASIS FOR CURRENT		
				%EST.	%CAL.	%ACT.
Structure	4029	+453	4482	60	40	
Crew Systems	520	-7	513	100		
Communication and Instrumentation	901	-12	889	100		
Guidance and Navigation	357	+74	431	100		
Stabilization and Control	201	+13	214	100		
Reaction Control	250	+17	267	100		
Electrical Power	385	+44	429	100		
Environmental Control	253	+9	262	100		
Earth Landing	502	-9	493	20	55	25
WEIGHT EMPTY	7398	+582	7980	72	26	2
Crew (3) (50, 70, 90 Percentile)	528		528		100	
Suits and Personal Equipment	132	+2	134	100		
Survival Water	18		18		100	
Food and Containers	90		90	100		
Reaction Control Propellant	210		210		100	
Environmental Control Chemicals	134	+6	140		100	
Scientific Payload	250		250	100		
GROSS WEIGHT	8760	+590	9350	67	32	1

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COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

STRUCTURE (+453)

The current Command Module structural weight of 4482 pounds is based on a high percentage of released and pre-released drawings for the primary inner structure and heat shield structure. Approximately 82% of the primary structural weight has been calculated based on these two types of drawings.

Due to the current weight increases, an intensive weight reduction program has been initiated to review the criteria and design. The preliminary results have indicated several areas where potential significant weight changes exist. These potential weight reductions are in the following categories:

1. Removal of weight penalties incorporated into present design due to impact attenuation provisions.
2. Reduction of ablator to be consistent with weights being negotiated with Avco.
3. Changes to existing design concepts to optimize design, improve load paths and increase structural efficiency.

The potential weight reductions listed above are discussed in more detail in Section V (Potential Weight and C.G. Changes).

CREW SYSTEMS (-7)

Add personal radiation dosimeter for three crewman per NASA requirement.	+5
Transfer Bio-medical instruments to useful load.	-5
Reduce personnel communication system per revised estimate.	-4
Reduce sleeping restraints per revised estimate.	-4
Delete sleeping and privacy curtains per latest requirement evaluation.	-2
Reduce waste management per calculations in lieu of estimates.	-5
Increase lighting system per revised estimate based on current requirements.	+11

COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

CREW SYSTEMS (Continued)	
Increase survival kit per revised estimate	+1
Increase food reconstitution device per revised estimate	+2
Delete extra vehicular accessories and add hatch egress accomodations	-9
Increase lap board per revised estimate	+1
Decrease in-flight test vest requirement to provide for tool belts only	-1
Add food preparation table per revised requirements	+3
COMMUNICATIONS AND INSTRUMENTATION	(-12)
Communications	
Reduce DSIF power amplifier due to revised vendor estimate	-3
Increase VHF/2-KMC omni antenna to incorporate different radome material and different foam potting, due to revised temperature requirements	+14
Decrease antennas and transmission lines due to reduced estimate for HF recovery antenna	-1
Decrease instrumentation sensors due to revised estimate	-15
Controls and Displays	
Addition, deletion and relocation of various displays and controls at the Control Station, Center Station, System Management Station, RH console and LH console to simplify controls	-9
Add:	
Service Module Quad. Temp. Ind.	+3
SCS Power Control Panel	+2
IFTS Scan Select Panel	+1
Lighting Control (2)	+2
Boost Emergency and Earth Landing	+3

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COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

COMMUNICATION AND INSTRUMENTATION (Continued)

Delete:

Docking Controls	-2
Rate of Climb	-1
Landing Display Control	-2
Earth Landing System	-4
Launch Escape System	-4
Egress Hatch Jettisoning System	-2

Revise:

Integrated Display	+2
SCS Control Panel	-2
Reaction Control System	-2
Service Module Propulsion	-3

Add loudspeaker at NASA request defined in abstract of electrical system meeting number 9 per letter 11120 MA. +2

GUIDANCE AND NAVIGATION (+74)

Change the weight of the following items in accordance with the latest MIT Report: +64

Sextant	-15
Telescope	+1
Navigation Base	-1
Power Servo Assy	+5
Cabling	+34
Spares	+40

Increase estimated NAA cabling +10

STABILIZATION AND CONTROL (+13)

Add BMAG Coupler +13

REACTION CONTROL SYSTEM (+17)

Increase the following items due to relocation of the tanks to the +Z axis to improve the reentry center of gravity. The increase is due to longer piping runs and larger tankage to store the increased unusable propellants. +20

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COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

REACTION CONTROL SYSTEM (Continued)

Propellant System

Tanks	+2
Plumbing	+13

Pressure System

Tanks	+4
Plumbing	+1

Change the following items based on calculations of revised schematics: -3

Propellant System

Valves and Regulators	+2
Sensors	-3

Pressure System

Valves and Regulators	+2
Sensors	-4

ELECTRICAL POWER (+44)

Increase installation provisions for the energy souce, power conversion and Electrical Utility System per revised estimates +2

Increase electrical utility umbilicals per calculations from layout drawings and include the transfer of ablative material from ablator and substructure. +42

ENVIRONMENTAL CONTROL SYSTEM (+9)

Change the following components per negotiations with Airesearch to further define the "C" change which removed certain redundancies and was part of a cost reduction: -41

Pressure Suit Components

Subcontracter Components	-8
Ducting, Conn., Clamps, etc.	-2

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COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

ENVIRONMENTAL CONTROL SYSTEM (Continued)		
Water Glycol Circuit		
Subcontractor Components	+5	
Water Glycol	-3	
Plumbing, etc.	-11	
Pressure and Temperature Control		
Subcontractor Components	-1	
Ducting	-4	
Oxygen Supply		
Subcontractor Components	+1	
Plumbing	-2	
Water Supply		
Subcontractor Components	-2	
Plumbing	-4	
Supports	-10	
Add the following items per Airesearch Weight Report:		+33
Brackets, Plumbing, Electrical Wiring	+20	
Instrumentation	+13	
Add gas analyzer, which is NASA furnished		+17
EARTH LANDING		(-9)
Increase the following items per Northrop Status Report:		+10
Main Cluster	+6	
Sequence Controller	+4	
Reduce location aids due to removal of the Shark Replellant Ejector		-1
Reduce attach provisions per calculations versus estimates		-7

COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

EARTH LANDING (Continued)	
Reduce Forward Heat Shield Release System for calculations versus estimates	-6
Reduce electrical pyrotechnic initiation provisions based on re-evaluation of system requirements	-5
TOTAL COMMAND MODULE WEIGHT EMPTY CHANGES	+582

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COMMAND MODULE

CURRENT USEFUL LOAD CHANGES

Transfer biomedical instruments from Crew Systems weight empty (+5 pounds) and re-estimated weight required to be 2 pounds in lieu of 5 pounds.	+2
Reduce personal hygiene equipment per re-evaluation of requirements and weight of personal shaver, ingestible dentifrice package, fecal and emesis bag set.	-3
Increase medical equipment due to reanalysis of requirements for 14 day mission.	+1
Increase chemical disinfectant per revised estimate	+2
Add containers for LiOH and Charcoal	+6
TOTAL COMMAND MODULE USEFUL LOAD CHANGES	+8

SERVICE MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 11-1-62	CHANGE TO CURRENT	CURRENT WEIGHT 12-1-62	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
Structure	3317	-644	2673	100		
Electronics	172	-6	166	100		
Reaction Control	641	-50	591	100		
Electrical Power	1097	+146	1243	100		
Environmental Control	86	-28	58	100		
Propulsion System						
Engine Installation	606		606	100		
Propellant System	2465	-9	2456	100		
WEIGHT EMPTY	8384	-591	7793	100		
Usable RCS Propellant	611		611		100	
Usable Supercritical Reactants	473	-42	431		100	
Environmental Control Fluids	191	+11	202		100	
Main Propulsion Helium	139		139		100	
Main Propellant Residuals	(900)		(900)		100	
Trapped	225		225			
Mixture Ratio Tolerance	450		450			
Loading Tolerance	225		225			
Unusable RCS Propellant	61		61		100	
Unusable Supercritical Reactions	6	+62	68		100	
BURNOUT WEIGHT	10765	-560	10205	76	24	
Main Propellant	45000		45000		100	
GROSS WEIGHT	55765	-560	55205	14	86	

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SERVICE MODULE

CURRENT WEIGHT EMPTY CHANGES

STRUCTURE	(-644)
Decrease the radial beams per load and structural configuration requirements	-200
Decrease the internal structure and engine compartment closeout per revised estimate and structural configuration	-88
Decrease the outer shell skin gage and honeycomb core depth per load requirements.	-88
Transfer the tank supports to the Propulsion System	-62
Decrease the antenna support structure per revised estimate	-5
Decrease the forward bulkhead per revised estimate	-3
Decrease the aft bulkhead per revised estimate	-30
Add tank support shelf in the equipment bay sextant I	+30
Delete insulation from the following items	-432
Outer shell -273 Fairing - Command to Service -10 Aft Bulkhead -149	
Add the insulation for complete service module structure	+432
Decrease the insulation using lower density material	-198
ELECTRONICS	(-6)
Decrease Instrumentation sensors consistent with present requirement	-10
Add instrumentation signal conditioning	+15
Delete IFTS panel installation	-11
REACTION CONTROL SYSTEM	(-50)
Reduce component unit weights consistent with specifications and revised schematics	-25
Reduce structural provisions for modular panels per revised estimate. Panels are partially supported by basic structure joints, and radial beams.	-25

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SERVICE MODULE

CURRENT WEIGHT EMPTY CHANGES

ELECTRICAL POWER SYSTEM	(+146)
Increase fuel cell power pack consistent with specification	+87
Increase fuel cell hydrogen and oxygen system per Beech Status	+102
Add wiring installation for supercritical gas system	+21
Delete fuel cell module mounts as they are included with the fuel cell power pack	-32
Reduce plumbing and valves per revised estimate	-32
ENVIRONMENTAL CONTROL SYSTEM	(-28)
Reduce water-glycol consistent with present requirements	-8
Reduce water-glycol components per airesearch status	-2
Reduce water-glycol plumbing and hardware per revised estimate	-14
Reduce water supply plumbing and hardware per revised estimate	-4
PROPULSION SYSTEM	(-9)
Reduce component unit weights to agree with specification	-9
TOTAL SERVICE MODULE WEIGHT EMPTY CHANGES	-591

SERVICE MODULE

CURRENT USEFUL LOAD CHANGES

Change supercritical reactants per revised estimate:		+20
Usable reactants	(-42)	
Hydrogen	-4	
Oxygen	-38	
Unusable Reactants	(+62)	
Hydrogen	+8	
Oxygen	+54	
Change environmental control fluids per revised analysis		+11
Reduce back pack oxygen	-9	
Add provisions for emergency cond.	+17	
Reduce residuals	-2	
Increase oxygen reserve	+5	
TOTAL SERVICE MODULE USEFUL LOAD CHANGES		+31

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LAUNCH ESCAPE SYSTEM

WEIGHT STATUS

ITEM	PREVIOUS STATUS 11-1-62	CHANGE TO CURRENT	CURRENT WEIGHT 12-1-62	BASIS FOR CURRENT		
				%EST	%CALC	%ACT
Structure	1091	+3	1094	11	89	
Electrical System	20		20	100		
Propulsion System						
Main Thrust	4826		4826	50	50	
Jettison	440		440	1	99	
Pitch Control	55		55	75	25	
LES - NO BALLAST	6432	+3	6435	40	60	
BALLAST	63	+157	220	100		
TOTAL L.E.S.	6495	+160	6655	42	58	

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LAUNCH ESCAPE SYSTEM

CURRENT WEIGHT CHANGES

ITEM		CURRENT WEIGHT 12-1-62
LAUNCH ESCAPE SYSTEM		
Structure		(+3)
Increase or decrease, as applicable, the weight of the following items based on calculations of released drawings versus previous estimates:		+3
Tower	-9	
Flow Separator and Skirt	+14	
Jettison Motor Skirt	+5	
Pitch Motor Structure	+18	
Nose Cone and Ballast Support	-7	
Attaching Parts	+3	
Tower Insulation	-5	
Skirt Insulation	-1	
Flow Separator Insulation	-15	
Ballast		(+157)
Increase ballast consistent with current balance requirement		+157
TOTAL LAUNCH ESCAPE SYSTEM		+160

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ADAPTER

WEIGHT STATUS

ITEM	PREVIOUS STATUS 11-1-62	CHANGE TO CURRENT	CURRENT WEIGHT 12-1-62	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
Structure	2892		2892			
Electrical	70		70			
Separation System	142		142			
Posigrade Rocket (4)	156		156			
TOTAL ADAPTER	3260		3260	100		

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WEIGHT HISTORY COMMENTS

LAUNCH ESCAPE SYSTEM

The target weight established for the LES is 6,300 pounds, excluding ballast. This weight was based on the September status weight of 6,600 pounds including the necessary ballast to provide currently determined aerodynamic stability to prevent tumbling.

The original target weight of 5,900 pounds as reported in the June Status, SID 62-99-5, was based on an attitude controlled configuration. The current configuration weight includes a flow separator, pitch motor, and ballast not included in the original target weight.

COMMAND MODULE

The target weight established for the Command Module is 8,500 pounds. an estimated weight breakdown for the target weight is provided for comparative purposes.

The original target weight of 8.340 pounds as reported in the June Status, SID 62-99-5, did not include the proposed increases nor the category I reductions presented in the July briefing and incorporated in the July Status report

SERVICE MODULE

The target weight established for the Service Module less usable propellant is 11,000 pounds. An estimated weight breakdown for the target weight is provided for comparative purposes. This configuration is sized for 45,000 pounds usable propellant for the 25,000 pound LEM.

The original target weight of 8,675 for the burnout condition was based on a lunar landing configuration sized for 31,000 pounds usable propellant..

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WEIGHT HISTORY

COMMAND MODULE

	ORIGINAL TARGET WT.	TARGET WEIGHT	AUTHORIZED CHANGES	AUTHORIZED WEIGHT 12-1-62
Structure	3670	3720	+399	4119
Crew Systems	565	690	+2	692
Communication & Instrumentation	944	785		785
Guidance & Navigation	310	310	+64	374
Stabilization & Control	175	195		195
Reaction Control	183	195		195
Electrical Power	354	390		390
Environmental Control	228	255		255
Earth Landing	530	610	-106	504
WEIGHT EMPTY	6959	7150	+359	7509
Crew	528	528		528
Suits & Personal Equipment	82	126		126
Survival Water	54	18		18
Food & Containers	90	90		90
Reaction Control Propellant	210	210		210
Environmental Control Fluids	167	128		128
Scientific Payload	250	250		250
GROSS WEIGHT	8340	8500	+359	8859

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COMMAND MODULE WEIGHT HISTORY

WEIGHT EMPTY AUTHORIZED CHANGES

STRUCTURE		(+399)
The following authorized structural weight changes were reported in the 1 November 1962 Weight and Balance Report:		+381
Approval for use of the low density AVCO ablator in the heat shield system was withheld pending the accumulation of more design data.	+380	
Delete readily removable items from the impact attenuation system & redesign as required.	+1	
The 1 November 1962 Weight and Balance report removed 149 pounds for impact attenaution fittings. However, 18 pounds has been found to be not readily removable with the current design concept of not removing provisions for impact attenaution that are buried in the honeycomb panels and welded or bonded to the face sheets.	+18	
COMMUNICATION & INSTRUMENTATION		(+2)
Add a loudspeaker in the crew compartment per NASA requast.		+2
GUIDANCE & NAVIGATION		(+64)
Increase the Guidance and Navigation per Recent Weight report from M.I.T. Since NAA does not have weight control responsibility for the M.I.T. Design, the weight changes in their Weight and Balance report will be considered as authorized changes.		+64
EARTH LANDING		(-106)
The removal of the impact attenuation system per TWX SM 032 dated 23 July 1960 was reported in the 1 November 1962 Weight and Balance report.		-106
TOTAL COMMAND MODULE WEIGHT EMPTY CHANGES		+359

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WEIGHT HISTORY

SERVICE MODULE

	ORIGINAL TARGET WT.	TARGET WEIGHT	AUTHORIZED CHANGES	AUTHORIZED WEIGHT 12-1-62
Structure	2810	3203		3203
Electronics	216	145		145
Reaction Control	254	737		737
Electrical Power	1076	1203		1203
Environmental Control	413	250		250
Propulsion System				
Engine Installation	375	606		606
Propellant System	1928	2456		2456
WEIGHT EMPTY	7072	8600		8600
Usable RCS Propellant	400	611		611
Usable Fuel Cell Reactants	380	479		479
Environ. Control Fluids	288	193		193
Main Propulsion Helium	97	139		139
Main Prop. Residuals	300	900		900
Unusable RCS Propellant	20	61		61
Unusable Fuel Cell Reactants	28	17		17
BURNOUT WEIGHT	8595	11000		11000
Main Propellant	31000	45000		45000
GROSS WEIGHT	39595	56000		56000

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POTENTIAL WEIGHT AND C.G. CHANGES

COMMAND MODULE

STRUCTURE (-604)

Decrease ablative to agree with the new reference design recommended by Avco. The change in design criteria for the new design is as follows: -384

	OLD DESIGN	NEW DESIGN
Type of wet blend ablative	5026-22	5026-39
Lift-off temperature	300°F	125°F
Blunt face prior to re-entry	300°F	100°F
Back face after touchdown	600°F	600°F or greater
Density (lb./ft.^{3})	58	37

Decrease primary structure based on revised criteria and redesign. The present structure has several areas of potential weight reduction in addition to reductions from potential criteria changes. A summary of these potential changes is as follows: -300

Reduce skin gauges, weld lands, core densities and fittings to minimum structural requirements and improve load paths to optimize disign as applicable. -130

Remove complete provisions for the Impace Attenuation System that have not been previously deleted as readily removable items. This consist of "Scar" weight buried in the existing design. -170

STABILIZATION AND CONTROL (+25)

Increase M-H electronic control amplifier for incorporation of signal ground isolator +25

TOTAL POTENTIAL WEIGHT CHANGES - COMMAND MODULE -659

A potential weight increase in the Command Module due to LEM docking will be included at a later date.

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POTENTIAL WEIGHT AND C.G. CHANGES

SERVICE MODULE	
STRUCTURE	(-114)
The removal of insulation from the radial beams may result from current Thermodynamics analysis.	-64
Revision of the Separation System to an explosive Bolt System	-50
TOTAL POTENTIAL WEIGHT CHANGES - SERVICE MODULE	-114

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

SUMMARY

ITEM		CURRENT WEIGHT 12-1-62
WEIGHT EMPTY		7980
Structure	4482	
Crew Systems	513	
Communication & Instrumentation	889	
Guidance & Navigation	431	
Stabilization & Control	214	
Reaction Control	267	
Electrical Power	429	
Environmental Control	262	
Earth Landing	493	
USEFUL LOAD		1370
Crew Systems	770	
Reaction Control	210	
Environmental Control	140	
Scientific Payload	250	
GROSS WEIGHT		9350

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

STRUCTURE

ITEM	CURRENT WEIGHT 12-1-62
STRUCTURE	
Heat Shield	(1489)
Forward Compartment	236
Crew Compartment	628
Aft Compartment	625
Inner Structure	(1060)
Forward Section	523
Aft Sidewall	359
Aft Bulkhead	178
Secondary Structure	(263)
Internal Cabin	253
Service Module Attach	10
Ablation Material	(1484)
Microfiber Insulation	(186)
TOTAL STRUCTURE	4482

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

CREW SYSTEMS

ITEM	CURRENT WEIGHT 12-1-62
CREW SYSTEMS	
Personal Radiation Dosimeter (NASA)	5
Portable Life Support System (2) (NASA)	60
Bio-Medical Inst. (NASA)	0
Personnel Communications (NASA)	5
Seat Liners & Restraint Harness	36
Sleeping Restraints	4
Curtain, Sleeping & Relief Privacy	0
Waste Management	25
Lighting System	15
Garments - Constant Wear (NASA)	9
Emergency Water Device	2
Survival Kit - Collective (1) (NASA)	54
Shoe Straps	2
Food Reconstitution Device	4
Log Book, Pencils etc.	1
Hatch Egress	3
Lap Board (2)	2
Manual - Maint. Maps, & Case	6
Suit Umbilical Hose	10
In-Flight Test Maintenance Tool Belt	1
Structural Seats & Supports	258
Nuclear Radiation Detectors	7
In-Flight Maintenance Tool	1
Food Preperation Table	3
TOTAL CREW SYSTEMS	513

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
COMMUNICATIONS & INSTRUMENTATION

ITEM	CURRENT WEIGHT 12-1-62
TELECOMMUNICATIONS	
Lower Bay	(265)
C-Band Transponder	16
DSIF Trans.-Rec.	16
DSIF Power Amplifier	13
DSIF Spare Module	18
VHF FM Transmitter	10
VHF AM Trans.-Rec.	14
HF Transceiver	10
VHF Recovery Beacon	7
Multiplexer	9
Antenna Switches	4
Spares	19
PCM Telemetry	
Analog Commutator	18
Analog Commutator	9
A/D Converter	7
Programmer	15
Calibrator	5
Power Supply	7
Signal Conditioner	10
Input Analog Patch	3
Digital Patch Panel	4
Output Analog Patch	3
Recorder	15
Audio Center	5
Premodulation Processor	18
Central Timing Equipment	10
Remote Equipment	(122)
VHF/2-KMC OMNI Antenna	53
Antennas & Transmission	30
TV Camera	4
Instrumentation Sensors	35
Supports	(12)
Electrical Provisions	(95)
Electronic Interface Provisions	(8)
Cooling Provisions	(20)
TOTAL TELECOMMUNICATION (to be brought forward)	522

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
COMMUNICATION AND INSTRUMENTATION

ITEM		CURRENT WEIGHT 12-1-62
CONTROLS AND DISPLAYS		
Main Display Panel Control Station		(62)
Integrated Display	C&I	10
GMT Clock	C&I	1
Computer Data Insert & Display	G&N	15
Time to & from Clock	G&N	2
SCS Control Panel	SCS	5
Delta Velocity Control	SCS	3
Flight Director Attitude Indicator	SCS	11
Gimbal Angle Indicator	SCS	2
Altimeter	SCS	2
Survival Indicator	E&A	8
Master Caution Lights	U	3
Main Display Panel Center Station		(37)
Audio Panel	C&I	1
8 Day Clock	C&I	1
Indicator Light & Abort Light	U	1
Reaction Control System	U	7
Service Module Propulsion	U	7
Booster Situation Indicator	U	2
ECS - Gas Control	U	6
ECS - Liquid Control	U	6
Service Module Quad. Temp. Ind.		3
SCS Power Cont..		2
IFTS Scan Select		1
Main Display Panel System Management Station		(40)
Communications Control Panel	C&I	8
Antenna Control	C&I	3
Abort Light & Master Caution	U	3
Power Distribution	U	12
Fuel Cell Reactants	U	9
Cryogenic Storage	U	5
Main Display Panel Installation Provisions		(25)
Main Display Right Hand Console	U	(11)
Nuclear Detection Display		3
Installation Provisions		6
Lighting Cont.		1
Audio Panel		1
Main Display Left Hand Console		(12)
Installation Provisions		7
Lighting Cont.		1
Audio Panel		1
Boost Emergency, Earth Landing		3
Electrical Provisions		(29)
Environmental Provisions		(9)
Loudspeaker		(2)
TOTAL CONTROLS AND DISPLAYS (to be brought forward)		227

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

COMMUNICATION AND INSTRUMENTATION

ITEM	CURRENT WEIGHT 12-1-62
IN-FLIGHT TEST (RIGHT BAY FORWARD)	(125)
Crew Readout Panel	3
Manual Test Unit	15
Comparator	12
Programmer	11
Stimuli Generator	24
Panel Assy	15
Installation Provisions & Connectors	5
In-Flight Test - GSE Electrical Provisions	40
CREW AREA CONTROLS	(15)
Manual Control - Three Axis	7
Manual Control - Translation & Thrust	8
TOTAL IN-FLIGHT TEST & CREW AREA CONTROLS	140
TOTAL CONTROLS AND DISPLAYS	227
TOTAL TELECOMMUNICATION	522
TOTAL COMMUNICATIONS AND INSTRUMENTATION	889

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

GUIDANCE & NAVIGATION

ITEM	CURRENT WEIGHT 12-1-62
GUIDANCE & NAVIGATION	
Lower Equipment Bay	
Inertial Platform	60
Sextant	12
Telescope - Scanning	9
Map & Visual Display	9
Display & Control - Navigation	40
Display & Control - Computer	15
Navigation Base	45
Computer	100
Power Servo Assy	29
Coupling Display Unit	6
Junction Box	11
Cabling	40
Spares	40
NAA Cabling	15
TOTAL GUIDANCE & NAVIGATION	431

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

STABILIZATION AND CONTROL

ITEM	CURRENT WEIGHT 12-1-62
STABILIZATION AND CONTROL	
Lower Equipment Bay	(159)
Rate Gyro Package	5
Body Mounted Gyro Package	15
Electronic Control Package No. 1	30
Electronic Control Package No. 2	30
Electronic Control Package No. 3	31
Accelerometer	5
Display Electronics	15
Spare Gyro - BMAG (2)	2
Spare Gyro - Rate	1
Spare Plug-in Module	12
BMAG Coupler	13
Supports	(12)
Electrical Provisions	(16)
Environmental Control Provisions	(27)
TOTAL STABILIZATION AND CONTROL	214

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

REACTION CONTROL SYSTEM

ITEM	CURRENT WEIGHT 12-1-62
REACTION CONTROL SYSTEM	
Propellant System	(81)
Tanks	17
Expulsion Devices & Tank Supports	12
Plumbing, Fittings & Insulation	23
Valves & Regulators	21
Sensors	1
Supports - Plumbing & Equipment	7
Pressure System	(49)
Tanks (4500 psi)	9
Tank Supports	3
Plumbing, Fittings & Insulation	4
Valves & Regulators	24
Sensors	2
Helium	1
Supports - Plumbing & Equipment	6
Engine System	(114)
Engines	108
Supports	6
Electrical Provisions	(23)
TOTAL REACTION CONTROL SYSTEM	267

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

ELECTRICAL POWER

ITEM	CURRENT WEIGHT 12-1-62
ELECTRICAL POWER	
Energy Source	(60.0)
Battery - Main (2)	36.0
Battery - Recovery (1)	18.0
Installation Provisions	6.0
Power Conversion	(107.6)
Inverter (3)	90.0
Inverter Controls	3.0
Battery Charger & Controls	5.0
Installation Provisions	9.6
Power Distribution & Control	(162.0)
Power Distribution Equipment	
Circuit Breakers	6.0
Battery Controls	5.0
No. 1 and No. 2 AC Bus Control	15.0
DC Busses (Diodes, etc.)	10.0
AC Busses	5.0
Utility System Controls	15.0
Mounting Hardware	2.0
Sequencer	10.0
Right Hand Circuit Breaker Panel	13.0
Terminal Panels	5.0
Power Distribution Wiring & Provisions	40.0
Lighting Wiring & Provisions	5.0
Ground Power Provisions	6.0
Power Control Panel Connectors	3.0
Installation Provisions	22.0
Electrical - Common Utility	(99.4)
Utility Wiring and Circuit Components	20.0
Left Hand Circuit Breaker Panel	7.0
Umbilicals	47.0
Posigrade Adapter Separation System	10.0
Launch Escape System Separation	5.0
Service Module Electrical Initiation	5.0
Installation Provisions	5.4
TOTAL ELECTRICAL POWER	429.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

ENVIRONMENTAL CONTROL SYSTEM

ITEM	CURRENT WEIGHT 12-1-62
ENVIRONMENTAL CONTROL SYSTEM	
Pressure Suit Circuit	(71.0)
Subcontractor Components	58.9
Ducting, Conn,, Clamps, etc.,	12.1
Water-Glycol Circuit	(49.4)
Subcontractor Components	31.5
Water-Glycol	14.3
Plumbing, etc.	3.6
Pressure & Temp. Control	(16.5)
Subcontractor Components	15.8
Ducting	0.7
Oxygen Supply System	(17.0)
Subcontractor Components	14.0
Plumbing	3.0
Water Supply System	(27.8)
Subcontractor Components	23.0
Plumbing	4.8
Subcontractor Common Items	(32.6)
Brackets, Plumbing, Elect. Wiring	20.0
Instrumentation	12.6
Gas Analyzer	(16.7)
Supports	(10.0)
Electrical Provisions	(21.0)
TOTAL ENVIRONMENTAL CONTROL SYSTEM	262.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

EARTH LANDING SYSTEM

ITEM	CURRENT WEIGHT 12-1-62
EARTH LANDING SYSTEM	
Parachute System	(463)
Drogue	40
Main Cluster	385
Sequence Control	22
Location Aids	11
Attach Provisions	5
Forward Heat Shield Release System	25
Electrical Pyrotechnic Initiation Provisions	5
TOTAL EARTH LANDING SYSTEM	493

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

USEFUL LOAD

ITEM	CURRENT WEIGHT 12-1-62
CREW SYSTEMS	(770)
Crew (3) (50, 70, 90, Percentile)	528
Pressure Garment Assy (3) (NASA)	90
Food	75
Food Containers	15
Water - Survival	18
Personal Hygiene Equipment	23
Biomedical Instrumentation (NASA)	2
Medical Equipment	15
Chemical Disinfectant	4
REACTION CONTROL	(210)
RCS Propellant	210
ENVIRONMENTAL CONTROL	(140)
Lithium Hydroxide	112
Activated Charcoal	4
Containers for LiOH & Charcoal	6
Oxygen - Re-entry	2
Water-Launch & Re-entry Cooling	10
Freon	6
SCIENTIFIC PAYLOAD	(250)
TOTAL COMMAND MODULE USEFUL LOAD	1370

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

SUMMARY

ITEM		CURRENT WEIGHT 12-1-62
WEIGHT EMPTY		7793
Structure	2673	
Electronics	166	
Reaction Control	591	
Electrical Power	1243	
Environmental Control	58	
Propulsion	3062	
USEFUL LOAD		2412
Reaction Control	672	
Electrical Power	499	
Environmental Control	202	
Propulsion	1039	
BURNOUT WEIGHT		10205
MAIN PROPELLANT		45000
GROSS WEIGHT		55205

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

STRUCTURE

ITEM	CURRENT WEIGHT 12-1-62
STRUCTURE	
Basic & Secondary Structure	
Radial Beams	477
Internal Structure & Engine Compartment Closeout	45
Outer Shell	920
Fairing - Command to Service	200
Engine Support	41
Tank Supports	0
Antenna Support Structure	30
Forward Bulkhead Including Ring	148
Aft Bulkhead	478
Separation Provisions	70
Tank Support Shelf	30
Insulation	234
TOTAL STRUCTURE	2673

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

ELECTRONIC SUBSYSTEMS

ITEM	CURRENT WEIGHT 12-1-62
ELECTRONICS SUBSYSTEM	
Communications	(72)
Antenna Dish	10
Antenna Gimbals	13
Antenna Deployment Booms	25
Antenna Coax Cabling	16
Antenna Coax Cabling Supports	3
Antenna Control Electrical Provisions	5
Instrumentation	(64)
Sensors	30
Electrical Provisions	14
Supports	5
Signal Conditioner	15
In-Flight Test Provisions	(30)
In-Flight Test & GSE Electrical Provisions	30
TOTAL ELECTRONICS SUBSYSTEMS	166

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

REACTION CONTROL

ITEM	CURRENT WEIGHT 12-1-62
REACTION CONTROL SYSTEM	
Propellant System	(153)
Tanks	46
Expulsion Devices & Tank Supports	36
Plumbing, Fittings & Insulation	17
Valves & Regulators	32
Sensors	6
Supports - Plumbing & Equipment	16
Pressure System	(132)
Tanks (4500 psi)	22
Tank Supports	6
Plumbing, Fittings & Insulation	4
Valves & Regulators	74
Sensors	9
Helium	3
Supports - Plumbing & Equipment	14
Engine System	(165)
Engines	55
Reflectors & Insulation	110
Structural Provisions	(80)
Electrical Provisions	(61)
TOTAL REACTION CONTROL SYSTEM	591

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

ELECTRICAL POWER

ITEM	CURRENT WEIGHT 12-1-62
ELECTRICAL POWER	
Fuel Cell Power System	(1110.0)
Fuel Cell Power Pack	732.0
Intermodular - Radiator Plumbing	12.0
Fuel Cell Module Mount Attach.	2.0
Fuel Cell H_2 System	
Subcontractor Components	122.0
Plumbing and Valves	3.0
Fuel Cell and ECS O_2 System	
Subcontractor Components	207.0
Plumbing and Valves	4.0
Water Glycol - Fuel Cell Heat Transfer System	7.0
Elect Wiring - Supercritical Gas	21.0
Power Distribution	(101.0)
Relays	10.0
Power Switch	5.4
Motor Switch	1.5
Umbilicals	64.1
Wiring & Busses	15.0
Supports	5.0
Electrical Utilities	(32.0)
Command - Service Separation System	3.0
Posigrade Adapter Separation System	10.0
Electrical Initiation of Pyrotechnics	17.0
Supports	2.0
TOTAL ELECTRICAL POWER	1243.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

ENVIRONMENTAL CONTROL SYSTEM

ITEM	CURRENT WEIGHT 12-1-62
ENVIRONMENTAL CONTROL SYSTEM	
Water-Glycol Circuit - Airesearch	(23.6)
Subcontractor Components	4.9
Plumbing and Hardware	4.4
Radiator Provisions	5.6
Water - Glycol	4.0
Supports	4.7
Water Supply System	(8.4)
Subcontractor Components	0.4
Plumbing and Hardware	6.0
Supports	2.0
Oxygen Supply System	(3.0)
Plumbing and Supports	3.0
Electrical Provision	(23.0)
TOTAL ENVIRONMENTAL CONTROL SYSTEM	58.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

MAIN PROPULSION

ITEM	CURRENT WEIGHT 12-1-62
MAIN PROPULSION	
Propellant System	(1489)
Tanks & Integral Doors	990
Tank Skirts	200
Plumbing, Fittings & Insulation	129
Valves	9
Quantity Indication	70
Mixture Ratio Control	12
Supports - Plumbing & Equipment	79
Pressure System	(941)
Tanks (4500 psi)	800
Tank Supports	30
Plumbing, Fittings & Insulation	24
Valves, Regulators & Heat Exchanger	49
Supports - Plumbing & Equipment	38
Engine System	(606)
Engine	606
Electrical Provisions	(26)
TOTAL MAIN PROPULSION SYSTEM	3062

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

USEFUL LOAD

ITEM		CURRENT WEIGHT 12-1-62
REACTION CONTROL		(672)
Usable Reaction Control System Propellant		611
Unusable Reaction Control System Propellant		61
ELECTRICAL POWER		(499)
Usable Supercritical Reactants		
Hydrogen (incl. 10% reserve)		48
Oxygen (incl. 10% reserve)		383
Unusable Supercritical Reactants		
Hydrogen		9
Oxygen		59
ENVIRONMENT CONTROL		(202)
Oxygen - ECS		202
PROPULSION		(1039)
Main Propulsion Helium		139
Main Propellant Residuals		900
Trapped	225	
Mixture Ratio Tolerance	450	
Loading Tolerance	225	
TOTAL USEFUL LOAD		2412

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DETAIL WEIGHT STATEMENT

LAUNCH ESCAPE SYSTEM

SUMMARY

ITEM	CURRENT WEIGHT 12-1-62
LAUNCH ESCAPE SYSTEM	
Structure	(1094)
Tower Assy.	306
Flow Separator and Skirt	285
Jettison Motor Skirt	94
Pitch Motor Structure	157
Nose Cone and Ballast Support	111
Attaching Parts	25
Tower Insulation	45
Skirt Insulation	26
Flow Separator Insulation	45
Ballast	(220)
Propulsion	(5321)
Escape Motor	4826
Jettison Motor	440
Pitch Control Motor	55
Electrical Power	(20)
TOTAL LAUNCH ESCAPE SYSTEM	6655

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DETAIL WEIGHT STATEMENT

ADAPTER

SUMMARY

ITEM	CURRENT WEIGHT 12-1-62
ADAPTER	
Structure	(2892)
Panels	1915
Frames	421
Thermal Insulation	556
Electrical Power	(70)
Separation System	(142)
Posigrade Rockets (4)	(156)
TOTAL ADAPTER	3260

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